Strategy for coal-washing operations in New Mexico

by Robert Shantz

New Mexico Bureau of Mines & Mineral Resources

A DIVISION OF
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY
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The purpose of this series is the immediate release of significant new information which otherwise would have to await release at a much later date as part of a comprehensive and formal document. These data are preliminary in scope, therefore, subject to revision and correction.

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DISCUSSION

The loss of about one-fifth the heating values during coal preparation has generally precluded the washing of New Mexico steam coals, although a few washeries are planned for high-ash coals. Nevertheless, the utilization of a washery at new operations with a multiproduct strategy might offer an economic advantage.

The proposed process would float 25 percent of the plus 5/16-inch coal at a specific gravity of about 1.35 resulting in a coal having 6 percent ash and 13,000 BTU/lb on a moisture-free basis. The sink coal would then be recleaned at 1.80 sp gr to reject a high-ash fraction (70 percent). The middlings, which would contain most of the heat value, would feed a mine-mouth power plant. An overall heat recovery of about 95 percent would result.

This strategy would allow production of significant tonnages of clean coal that could be used for several purposes. First, the coarse fraction of the 6 percent ash, low-sulfur material would command a premium for firing industrial boilers. Its lower shipping cost per million BTU would offer considerable advantage to distant utilities. Finally, this clean material could be used to fire one unit of a multiunit mine-mouth plant resulting in significantly less pollution-control equipment for that unit.

The feasibility of such a strategy would clearly depend on local conditions. For example, a utility-owned mine supplying a single-unit mine-mouth plant could not apply this strategy. However, an independent coal producer supplying primarily a large utility customer and also having excess production capacity should consider this strategy. Different mines in the same area supplying mine-mouth units and the other distant utilities might find a joint operation mutually beneficial.

Fig. 1 presents an example of a possible operation based on the following assumptions:
- Run-of-mine coal is crushed to approximately 2” x 0, and contains 25% ash
- The split on the 5/16” screen will be 75% to oversize
- Neither ash nor BTU varies significantly with size
- 25% of the oversize will float at 1.35 sp gr to give a coal of 6% ash
- 15% of the oversize will sink at 1.80 sp gr to give a reject containing 70% ash
- Moisture content of the oversize will not be significantly affected by the wash method
- The heating value on a moisture-free basis can be calculated from $\text{BTU/lb} = 14,000 - 15,740 \times (\text{ash fraction})$.

The author believes these assumptions are reasonable for operations in the San Juan Basin; supporting data are presented in the Appendix. However, feed ash and ash distribution vary greatly within the basin; each property should be evaluated on its own merits. All values in Fig. 1 are on a moisture-free basis; the BTU values were calculated from the basinwide correlation described in the Appendix.

To avoid the expense of dewatering and drying, the fines have not been cleaned (Fig. 1). Their treatment should also be considered. The coarse cleaning could probably be best accomplished with heavy media vessels and cyclones (after additional sizing at about 3/4 inch) because of the sharp separation attainable. Dewatering screens should provide adequate drying on these coarse sizes. Magnetite for heavy media could be obtained as a byproduct from some of the copper producers in the state, or from some small operators. Water-only jigs and cyclones should also be considered.

As shown in Fig. 1, 19 percent by weight of the coal, containing 24 percent of the heating value, reports to the 6 percent ash fraction. For a mine producing 5-10 million TPY (tons per year), this recovery represents a considerable amount of coal. The grade of the remaining material is maintained by an additional cleaning stage that should not increase washery costs significantly.

The overall heat recovery of 97 percent leads to minimal costs as a result of heating value losses. Whether the increased value of the cleaned coal is sufficient to offset the washing costs of $0.50 - $2.00/ton (depending on the estimates used) must be evaluated for each case. The economic feasibility of such a scheme requires a buyer willing to pay a premium for the coal sufficient to justify the washery, as well as one (such as a mine-mouth plant) who is willing to consume all the middlings.

ACKNOWLEDGMENT — This work was supported in part by a grant from the New Mexico Energy Resources Board.
**FIGURE 1** – Diagram of proposed strategy for washing coal (values on moisture-free basis).
APPENDIX

Numerous washability tests on drill cores from the San Juan Basin are presented in Memoir 25 of the New Mexico Bureau of Mines and Mineral Resources. Data for the float 1.3 and sink 1.8 fractions have been extracted for table 1. These data are consistent with experimental results obtained by the author on stockpile samples from existing operations. The assumed values of 6 percent ash and 25 percent by weight for the float 1.35 fraction and 70 percent ash and 15 percent by weight for the sink 1.80 fraction are within the experimental range.

The results presented in Memoir 25 as well as those developed by the author of this report indicate that ash varies little with size up to about 1¼ inches (except for the minus 100 mesh material which is markedly higher in ash, but relatively insignificant on a weight percent basis). Thus, the BTU content is also assumed to vary little with size. The top size at which this assumption prevails is unknown.

The assumption that only 75 percent by weight will report to the 5/16-inch screen oversize is based on the screen data in Memoir 25 for 3/8 inches x 0; this figure is probably conservative. If large top sizes can be used, a much higher fraction reporting to cleaning will probably be possible.

The heat content correlation for San Juan Basin coals was developed from a wide range of coal analyses throughout the basin. The results of this study will be published by Coal Mining and Processing, vol. 14, no. 5, May 1977 and in a forthcoming circular of the New Mexico Bureau of Mines and Mineral Resources on coal preparation in New Mexico. A summary of the correlation constants (a and b) is given in table 2. The heat content on a moisture-free basis of the San Juan Basin coals can be predicted with a linear correlation of the following form:

\[ \text{BTU/lb} = a - b \text{ (ash fraction).} \]
### TABLE 1 - Washability data for San Juan Basin coals (source: Memoir 25, New Mexico Bureau of Mines and Mineral Resources).

<table>
<thead>
<tr>
<th>Area</th>
<th>Core hole No.</th>
<th>Size</th>
<th>Float 1.30 Wt. %</th>
<th>Float 1.30 Ash %</th>
<th>Sink 1.80 Wt. %</th>
<th>Sink 1.80 Ash %</th>
<th>Feed Ash %</th>
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<tr>
<td>Cortez</td>
<td>8</td>
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<td>5.6</td>
<td>44.5</td>
<td>79.3</td>
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<td>8</td>
<td>3/8x0</td>
<td>2.3</td>
<td>5.4</td>
<td>46.6</td>
<td>79.6</td>
<td>48.4</td>
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<tr>
<td>Newcomb</td>
<td>5</td>
<td>3/8x0</td>
<td>15.5</td>
<td>6.0</td>
<td>2.1</td>
<td>57.7</td>
<td>26.4</td>
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<tr>
<td></td>
<td>5A, Sample A</td>
<td>3/8x0</td>
<td>43.5</td>
<td>6.0</td>
<td>3.3</td>
<td>66.6</td>
<td>14.7</td>
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<tr>
<td></td>
<td>5A, Sample B</td>
<td>3/8x0</td>
<td>52.4</td>
<td>5.4</td>
<td>3.1</td>
<td>64.8</td>
<td>12.2</td>
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<td>Bisti</td>
<td>12, Sample A</td>
<td>1½x0</td>
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<td>6.6</td>
<td>11.9</td>
<td>73.3</td>
<td>23.6</td>
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<tr>
<td></td>
<td>12, Sample B</td>
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<td>29.1</td>
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<td>72.5</td>
<td>23.3</td>
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<tr>
<td></td>
<td>12, Sample C</td>
<td>3/8x0</td>
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<td>6.0</td>
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<td>71.8</td>
<td>16.5</td>
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<td></td>
<td>13, Sample A</td>
<td>3/8x0</td>
<td>34.0</td>
<td>5.0</td>
<td>7.3</td>
<td>71.3</td>
<td>16.6</td>
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<tr>
<td></td>
<td>13, Sample B</td>
<td>3/8x0</td>
<td>25.1</td>
<td>5.6</td>
<td>15.3</td>
<td>74.3</td>
<td>23.5</td>
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<td>13, Sample C</td>
<td>3/8x0</td>
<td>24.2</td>
<td>4.5</td>
<td>16.1</td>
<td>72.7</td>
<td>22.8</td>
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<td></td>
<td>15, Sample A</td>
<td>3/8x0</td>
<td>40.5</td>
<td>5.8</td>
<td>5.8</td>
<td>69.1</td>
<td>20.0</td>
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<td>15, Sample B</td>
<td>3/8x0</td>
<td>38.1</td>
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<td>69.7</td>
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<tr>
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<td>15A</td>
<td>3/8x0</td>
<td>42.2</td>
<td>5.5</td>
<td>8.6</td>
<td>69.1</td>
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<td>Chaco Canyon</td>
<td>7A</td>
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<td>69.8</td>
<td>70.6</td>
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<tr>
<td>Star Lake</td>
<td>11, Sample A</td>
<td>1½x0</td>
<td>26.9</td>
<td>6.1</td>
<td>6.2</td>
<td>70.8</td>
<td>20.3</td>
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<tr>
<td></td>
<td>11, Sample B</td>
<td>3/8x0</td>
<td>25.8</td>
<td>4.9</td>
<td>7.9</td>
<td>72.2</td>
<td>19.0</td>
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<tr>
<td></td>
<td>11, Sample C</td>
<td>3/8x0</td>
<td>19.0</td>
<td>5.7</td>
<td>22.5</td>
<td>78.7</td>
<td>34.1</td>
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<tr>
<td>Standing Rock</td>
<td>3A, Sample A</td>
<td>3/8x0</td>
<td>77.0</td>
<td>4.4</td>
<td>1.0</td>
<td>55.4</td>
<td>7.9</td>
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<tr>
<td></td>
<td>3A, Sample B</td>
<td>3/8x0</td>
<td>86.7</td>
<td>4.1</td>
<td>0.8</td>
<td>50.6</td>
<td>5.7</td>
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<tr>
<td></td>
<td>3A, Sample C</td>
<td>3/8x0</td>
<td>60.4</td>
<td>5.2</td>
<td>6.5</td>
<td>58.9</td>
<td>14.4</td>
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<tr>
<td></td>
<td>3B, Sample A</td>
<td>3/8x0</td>
<td>44.7</td>
<td>4.0</td>
<td>14.7</td>
<td>73.7</td>
<td>21.4</td>
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<tr>
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<td>3B, Sample C</td>
<td>3/8x0</td>
<td>63.6</td>
<td>4.4</td>
<td>10.2</td>
<td>75.0</td>
<td>16.3</td>
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<tr>
<td></td>
<td>16</td>
<td>3/8x0</td>
<td>61.6</td>
<td>4.5</td>
<td>3.3</td>
<td>74.1</td>
<td>11.9</td>
</tr>
</tbody>
</table>

### TABLE 2 - Correlation constants for ash fraction and BTU content of San Juan Basin coals.

<table>
<thead>
<tr>
<th>Area or source</th>
<th>95% confidence intervals</th>
<th>Standard deviation*</th>
<th>Number of data points</th>
<th>Reference**</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Juan Basin</td>
<td>14,000±40</td>
<td>15,740±410</td>
<td>409</td>
<td>724</td>
</tr>
<tr>
<td>Delivered coal</td>
<td>14,880±690</td>
<td>19,760±12,780</td>
<td>161</td>
<td>64</td>
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<tr>
<td>Core analysis</td>
<td>13,880±40</td>
<td>15,260±120</td>
<td>216</td>
<td>210</td>
</tr>
<tr>
<td>San Juan and McKinley Counties</td>
<td>14,050±110</td>
<td>14,350±1,210</td>
<td>197</td>
<td>149</td>
</tr>
<tr>
<td>Rio Arriba County</td>
<td>14,930±270</td>
<td>15,430±2,360</td>
<td>154</td>
<td>33</td>
</tr>
<tr>
<td>Newcomb</td>
<td>13,630±150</td>
<td>15,510±450</td>
<td>185</td>
<td>24</td>
</tr>
<tr>
<td>Bisti</td>
<td>13,470±172</td>
<td>15,140±490</td>
<td>440</td>
<td>80</td>
</tr>
<tr>
<td>Star Lake</td>
<td>13,880±150</td>
<td>15,900±410</td>
<td>247</td>
<td>36</td>
</tr>
<tr>
<td>Standing Rock</td>
<td>13,710±130</td>
<td>15,340±390</td>
<td>257</td>
<td>45</td>
</tr>
</tbody>
</table>

* Actual vs calculated BTU content (in BTU/lb)

**1 = Company data; 2 = Pillmore, C.L., and Hatch, J.R., 1976, U.S. Geological Survey, Open-